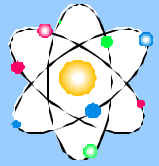




WPAFB RADIATION SAFETY OFFICE
EXCEPTED PACKAGE SHIPMENT DETERMINATION AND
QUALITY ASSURANCE CHECKLIST



The purpose of this document is twofold. First, to assist you in determining if your shipment meets the requirements for an Excepted Package Shipment as set forth in Title 49 Code of Federal Regulations 173.426. Second, if it **is** an Excepted Package, to help you fill out a Shipment Quality Assurance Checklist and the shipping document (DD Form 1149). You should go through this worksheet for **each** package being shipped.

The information you **must** have before proceeding:

1. A list of each isotope you are shipping (i.e., Ra-226, H-3 {Tritium}, U-238 {Depleted Uranium}, etc.).
2. Activity (amount of radioactive material) in **each** item you are shipping.
3. Total activity of **each** isotope in **each** package. If the items have not yet been packaged, this document will assist you in determining what can be placed in each package to meet the Excepted Package requirements.
4. Once packaged, you will need to measure all surfaces of each package to find the maximum radiation level, expressed in millirem per hour (mrem/hr).

A. Type of Radioactive Material

Type of Material	Clear this table.
<input type="checkbox"/>	Special Form
<input type="checkbox"/>	Normal Form

Is the radioactive material “Normal” or “Special” Form? If you aren’t sure, it is probably normal form. You must possess specific documentation certifying a source as “Special Form”. This also determines the maximum activity of radioactive material allowed. As discussed below, the A_1 limit is for special form and the A_2 is for normal form

Normal form: Radioactive material, which has not been demonstrated to qualify as “special form radioactive material.”

Special form: Radioactive material which satisfies: 1) single solid piece or in a sealed capsule that can only be opened by destroying capsule; 2) piece or capsule has at least one dimension not less than 5 mm; and 3) it satisfies test requirements of 49 CFR 173.469. The shipper must keep documentation demonstrating special form must be kept on file for at least one year after the latest shipment..

You are now ready to proceed.

B. Excepted Package Determination:

Amount of radioactive material allowed and determine the Shipment Type
{49 CFR 173.421 through 173.426}

1.

YES	NO	See following text for assistance. If the answer to <u>any</u> of these questions is NO, this is not an excepted package shipment. STOP – Call our office for further assistance.	Clear this table.
<input type="checkbox"/>	<input type="checkbox"/>	Does the package contain less than 15 grams of U-235?	

The Department of Transportation has established activity limits for each isotope being shipped. Referred to as the “ A_1 and A_2 ” values, they can be found in 49 CFR 173.435. A multiplier based upon the type of shipment being made then alters these limits. For excepted package, this is generally 10^{-2} or 10^{-3} , and can be found in Table 7 of 49 CFR 173.425. Tritium (H-3) is the exception to this rule and has it’s own multiplier.

Example: Instrument or Article, Normal Form, Ra-226 has an A₂ limit of 0.541 curies (541 millicuries). The multiplier for each item is 10⁻² and the package limit is the A₂ value. Doing the math, (541 mCi x 10⁻²) = 5.41 mCi. Therefore, for an Instrument or Article shipment, no single item of normal form Ra-226 may contain more than 5.41 mCi and the package may not exceed 541 mCi.

We have done the math and created the following table for selected isotopes:

{Ci = curies, mCi = millicuries, µCi = microcuries}

ACTIVITY LIMITS
INSTRUMENTS & ARTICLES and LIMITED QUANTITY
{49 CFR 173.425}

Radionuclide	NORMAL FORM			SPECIAL FORM		
	Instrument & Articles		Limited Quantity	Instrument & Articles		Limited Quantity
	Instrument Limit	Package Limit		Instrument Limit	Package Limit	
Americium 241	54.1 µCi	5.41 mCi	5.41 µCi	541 mCi	54.1 Ci	54.1 mCi
Cesium 137	135 mCi	13.5 Ci	13.5 mCi	541 mCi	54.1 Ci	54.1 mCi
Krypton 85	270 mCi	2.7 Ci	270 mCi	541 mCi	5.41 Ci	541 mCi
Nickel 63	8.11 Ci	811 Ci	811 mCi	10.8 Ci	1080 Ci	1.08 Ci
Plutonium 239	54.1 µCi	5.41 mCi	5.41 µCi	541 mCi	54.1 Ci	54.1 mCi
Polonium 210	5.41 mCi	541 mCi	541 µCi	10.8 Ci	1080 Ci	1.08 Ci
Promethium 147	243 mCi	24.3 Ci	24.3 mCi	10.8 Ci	1080 Ci	1.08 Ci
Radium 226	5.41 mCi	541 mCi	541 µCi	81.1 Ci	8.11 Ci	8.11 Ci
Tritium ¹	21.6 Ci	216 Ci	21.6 Ci	n/a	n/a	n/a
NOTES:						
¹ These values also apply to tritium in activated luminous paint and tritium absorbed on solid carriers.						

2.

Unity Determination: This must be accomplished **if** the package being shipped contains more than one isotope. The math is straightforward. It is the sum of the amounts divided by the allowable. Start with the Limited Quantity limits above. If unity is exceed, you will have to put the different isotopes into separate containers or try the Instrument & Article package limit.

YES	NO	See following text for assistance. If the answer to this question is NO, this is not an excepted package shipment. STOP – Place the different isotopes into separate containers and continue or call our office for further assistance.	Clear this table.
		If the package contains more than one isotope, is UNITY calculation equal to or less than 1.0?	

EXAMPLE: The package contains 10 lensatic compasses each containing 120 mCi of H-3 {1200 mCi or 1.2 Ci total}, 1 aircraft dial containing 0.015 mCi of Ra-226 {0.015 mCi total}, and 3 check sources containing 1.0 µCi of Cs-137 {3 µCi}.

$$\left(\frac{1.2Ci}{216Ci} \right) + \left(\frac{0.015mCi}{514mCi} \right) + \left(\frac{3mCi}{13.5mCi} \right) = 0.228$$

For this example, unity has not been exceeded (sum is not greater than 1.0).

Remember, this worksheet needs to be performed on each package being shipped.

3.a.

Limited Quantity: A Class 7 (radioactive) material whose activity per package does not exceed the specified limits.		<i>Clear this table.</i>
Enter the Limited Quantity package Limit from the table above:		
Enter the total activity in the package being shipped.		
If the number on the right equals or is less than 0, the activity limits for a Limited Quantity Shipment have not been exceeded. If greater than 0 this cannot be Limited Quantity. Try Instrument or Article.		

3.b.

YES	NO	If the answer to this question is NO, the package does not meet 49 CFR 173.421 requirements. STOP – Place the marking or call our office for further assistance.	<i>Clear this table.</i>
		For LIMITED QUANTITY ONLY, does the outside of the inner package or the outside of the package itself bear the marking “Radioactive”?	

3.c.

YES	NO		<i>Clear this table.</i>
		If you have met all the above criteria, are you going to ship as “Limited Quantity”? If yes, skip the following portion (4. Instrument or Articles). Go to item 5.	

4.a.

Instrument or Article: Any manufactured instrument and article such as an instrument, clock, electronic tube or apparatus, or similar instrument and article have Class 7 (radioactive) material in gaseous or non-dispersible solid form as a component part.		<i>Clear this table.</i>
Enter the Instrument Activity Limit from the table above:		
Enter the maximum instrument activity in the package being shipped.		
Enter the package Activity limit for Instrument or Article.		
Enter the total activity in the package being shipped.		
If the number on the right is greater than 0 this cannot be shipped as Instrument or Article. STOP!		
If the number on the right is greater than 0, you have too much material in the package. STOP! Repackage or call our office for assistance.		
If both number are equal to or less than 0, the activity limits for an Instrument or Article Shipment have not been exceeded.		

INSTRUMENTS or ARTICLES = ≤ 0.005 mSv/hr (0.5 mrem/hr) on any surface and ≤ 0.1 mSv/hr (10 mrem/hr) at 10 cm (4 inches) from external surface of instrument.

4.b.

YES	NO	If the answer to this question is NO, this is not an Instrument or Article shipment. STOP – Call our office for further assistance.	<i>Clear this table.</i>
		For INSTRUMENTS OR ARTICLES ONLY, is the radiation level at 10 cm from any point on the external surface of any unpacked instrument or article equal to or less than 10 mrem/hr?	

4.c.

YES	NO		<i>Clear this table.</i>
		If you have met all the above criteria, are you going to ship as “Instrument or Article”?	

5.

YES	NO	If the answer to this question is NO, this is not a Limited Quantity/Instrument or Article shipment. <u>STOP</u> – Call our office for further assistance.	Clear this table.
		Is the radiation level on contact with all surfaces of the package less than or equal to 0.5 mrem/hr?	

6.

Type of Shipment	Clear this table.
	Limited Quantity
	Instruments or Articles

**Package Determination
{49CFR173.410}**

7.

YES	NO	See following text for assistance. If the answer to this question is NO, this is not an excepted package shipment. <u>STOP</u> – Call our office for further assistance.	Clear this table.
		Does the package meet the general design requirements listed below?	

General Design Requirements:

1. Easily handled and secured in or on conveyance.
2. If lifting attachment, designed with safety factor.
3. External surfaces free from protruding features and easily decontaminated.
4. Outer layer will avoid water collection.
5. Each feature added does not reduce safety of package.
6. Withstands conditions of normal transport including closing devices.
7. Materials inside the package are physically and chemically compatible.
8. Values protected against unauthorized operation
9. For transport by air – a) temperature of surface will not exceed 50°C with ambient temperature at 38°C, b) integrity maintained if ambient temperature at – 40°C to 55°C, and c) liquids will not leak at pressure differential of not less than 95 kPa (13.8 lb/in²).

Examples of acceptable packages include cardboard boxes, drums, wooden boxes, etc.

**NON-FIXED EXTERNAL RADIOACTIVE
CONTAMINATION-WIPE LIMITS
{49 CFR 173.443}**

8.

YES	NO	See following text for assistance. If the answer to this question is NO, this is not an excepted package shipment. <i>STOP</i> – Call our office for further assistance.	<i>Clear this table.</i>
		Is removable surface contamination less than 2.2 dpm/cm ² (alpha) or 22 dpm/cm ² (beta/gamma)?	

Wipe tests are to cover 300 cm² area of the package.

Contaminant	Maximum permissible limits		
	Bq/cm ²	uCi/cm ²	dpm/cm ²
Beta and gamma emitters and low toxicity alpha emitters	0.4	10 ⁻⁵	22
All other alpha emitting radionuclides	0.04	10 ⁻⁶	2.2

Swipe Evaluation using an ADM-300:

$$\frac{Bq}{cm^2} = \frac{cpm (net)}{E_c \times 60 \frac{sec}{min} \times A(cm^2)}$$

E_c = Probe Efficiency (AP-100 probe = 0.3 for ²³⁹Pu; BP-100 probe = 0.3 for ⁹⁰Sr)

A = Area Swiped (300 cm²) about a seven inch square.

cpm_(net) = Background subtracted from gross count

Note: 1 Bq = 1 dps or 60 dpm

EXAMPLE:

$$\frac{Bq}{cm^2} = \frac{200 cpm}{0.3 \times 60 \frac{sec}{min} \times 300 cm^2} = \frac{200}{5400} = 0.037 \frac{Bq}{cm^2}$$

$$0.037 \frac{Bq}{cm^2} \times 60 \frac{dpm}{Bq} = 2.22 \frac{dpm}{cm^2}$$

B.

You have now answered all the questions required to determine if this package can be sent as a “Limited Quantity” or “Instruments or Articles” shipment. Blanks on the following page, along with answers already provided, will prepare the majority of the “Shipment Quality Assurance Checklist” and the DD Form 1149, “Requisition and Invoice/Shipping Document”.

If you have any questions, you may contact our office at DSN 787-2010 or commercial (937) 257-2010.

Specific Required information

Directions: Completing this section will insert information onto the QA checklist and the DD Form 1149. Hold down the shift key and hit ENTER to go to the next line of an entire (i.e., To and From). Go to the forms and make any final edits and add any supplemental information.

Consignee (To) Name and Address	<i>Clear this table.</i>

Consignor (From) Name and Address	<i>Clear this table.</i>

Today's Date	<i>Clear this table.</i>

Date Shipment needed at Destination:	<i>Clear this table.</i>

<i>Clear this table.</i>				
Item Description	Radionuclide	Activity Each (mCi)	Number of Items	Total Activity

Type of Shipment	<i>Clear this table.</i>
<input type="checkbox"/> Limited Quantity	
<input type="checkbox"/> Instruments or Articles	

Survey Information	<i>Clear this table.</i>
	Meter Manufacturer
	Meter Model Number
	Meter Serial Number
	Calibration Date
	mR at package Surface mR = milliroentgen
	Name of person performing survey.

Select the **PRINT** button on the bottom of this page.
Select pages 7 & 8 to get hard copies of the forms.
The **SUBMIT** button will send an information copy to
Wright Patterson Radiation Safety via email. Address
to embweb@wrigem.wpafb.af.mil.



**WPAFB RADIATION SAFETY OFFICE
SHIPMENT QUALITY ASSURANCE CHECKLIST**



March 1999

Date: _____ **Shipper:** _____ **Destination:** _____

Item Description	Radionuclide	Activity Each (mCi)	Number of Items	Total Activity

Radiation Package Survey Results: surface _____ mrem/hr 1 meter _____ N/A _____ mrem/hr

Instrument Used: Mfgr: _____ Model _____ S/N: _____

Calibration Date: _____

Person Completing Checklist: _____ **Signature:** _____

EXCEPTED PACKAGE SHIPMENT

Yes No

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

1. Package meets general design requirements (see definitions).
2. Package contains less than 15 grams of U-235.
3. Activity less than §173.425, Table 7 (A₁/A₂ Quantity Limits are found in §173.435). Shipment as:

☐

Limited Quantity

Package Activity Limit _____ Total Package Activity _____

☐

Instruments or Articles

Item Activity Limit _____ Maximum item Activity _____

Package Activity Limit _____ Total Package Activity _____

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

4. Radiation level at any point on the external surface of package less than or equal to 0.5 mrem/hr.
- 4a. For **Instruments or Articles only**. Is radiation level at 10 cm from any point on the external surface of any unpackaged instrument or article equal to or less than 10 mrem/hr?
5. Removable surface contamination less than 2.2 dpm/cm² (alpha) or 22 dpm/cm² (beta/gamma).
6. Notice enclosed in or on the package includes name of consignor or consignee and the following statement:

IMPORTANT: If you checked "no" to any item above, contact WPAFB Radiation Safety Office for further instruction.

COMMENTS:

REQUISITION AND INVOICE / SHIPPING DOCUMENT										Form Approved OMB No 0704-0746			
Public reporting burden for this collection of information is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0246), Washington, DC 20503													
1 FROM: (Include ZIP Code)						SHEET NO.	NO. OF SHEETS	5. REQUISITION DATE		6. REQUISITION NUMBER			
						7. DATE MATERIAL REQUIRED (YYMMDD)				8. PRIORITY			
2 TO: (Include ZIP Code)						9. AUTHORITY OR PURPOSE							
						10. SIGNATURE				11a. VOUCHER NUMBER & DATE (YYMMDD)			
3 SHIP TO - MARK FOR						12. DATE SHIPPED (YYMMDD)				b.			
						13. MODE OF SHIPMENT				14. BILL OF LADING NUMBER			
						15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NO.							
4. APPROPRIATIONS SYMBOL AND SUBHEAD				OBJECT CLASS	EXPENDITURE (FROM)	ACCOUNT (TO)	CHARGEABLE ACTIVITY		BUREAU CONTROL ACTIVITY NO		BUREAU CONTROL NO	AMOUNT	
ITEM NO.	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL AND / OR SERVICES					UNIT OF ISSUE	QUANTITY REQUESTED	SUPPLY ACTION	TYPE CON-TAINER	CON-TAINER NOS.	UNIT PRICE	TOTAL COST	
(a)	(b)					(c)	(d)	(e)	(f)	(g)	(h)	(i)	
16. TRANSPORTATION VIA MATS OR SMTS CHARGEABLE TO						17. SPECIAL HANDLING							
18. RECEIPT PREPARED BY	ISSUED BY		TOTAL CON-TAINERS	TYPE CON-TAINER	DESCRIPTION		TOTAL WEIGHT	TOTAL CUBE	19. RECEIPT	CONTAINERS RECEIVED EXCEPT AS NOTED	DATE(YYMMDD)	BY	SHEET TOTAL
	CHECKED BY									QUANTITIES RECEIVED EXCEPT AS NOTED	DATE(YYMMDD)	BY	GRAND TOTAL
	PACKED BY									POSTED	DATE(YYMMDD)	BY	20. RECEIVER'S VOUCHER NO.
	TOTAL												